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PATENT TRADEMARK OFFICE

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Description

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A Thermal Barrier for a Cabinet

Technical Field

The present invention relates generally to thermal barriers for use in a temperature controlled cabinet and more particularly to a thermal barrier curtain that allows the air from within the cabinet to circulate to the storage area of the cabinet door.

Background of the Invention

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Commercial businesses as well as private homes commonly use refrigerators to preserve the freshness of food by regulating the temperature to a level sufficient to slow food aging and to reduce contamination by bacteria. Consumption of food contaminated with bacteria often results in what is generally called food poisoning and is a common problem with improperly stored foods.

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Shell eggs are among the most nutritious foods and are recommended as part of a healthy diet, but they are extremely susceptible to the bacteria *Salmonella Enteriditis*. *Salmonella Enteriditis* attaches to the shell surface during the egg laying process or when the egg comes in contact with feces prior to collection. Much of the bacteria is removed during the washing and sanitizing process prior to sale, however as with most processes, they may not eradicate all of the bacteria. In addition if an egg rests against already contaminated food or is handled with contaminated hands, the bacteria may be

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5 reintroduced on the eggshell. Bacterial growth is
facilitated when condensation accumulates on the exterior
of the eggshell surface often times resulting when the
refrigerator door is opened. Because of this several
government agencies recommend not leaving eggs at ambient
10 temperature for more than two hours after refrigeration.

The safety of shell eggs has been a long term
problem and has prompted the Federal Drug Administration
(FDA), Animal Plant Health Inspection Service (AIPHIS),
Food Safety and Inspection Service (FSIS), Agricultural
15 Research Service (ARS), National Agricultural Statistics
Service (NASS), as well as state agriculture departments
and state and local health departments to cooperate to
ensure the safety of shell eggs from farm to table. On
August 27, 1999 the FSIS ruled that shell eggs packed for
20 consumers must be stored and transported under
refrigeration at an ambient temperature not to exceed
45°F. However, the recommendation for home storage of
eggs by the FSIS is even stricter. The FSIS recommends
consumers transport eggs immediately to a refrigerator
25 and store them immediately at or below 40°F to decrease
the likelihood of *Salmonella Enteriditis* contamination.

The FSIS suggests keeping eggs within the coldest
region of the refrigerator and not in the storage door.
However, even with this warning many consumers still keep
30 their eggs in the door of the refrigerator. Moreover,
many manufacturers have incorporated removable egg trays
that fit in the storage door and still others have molded
egg trays built into the storage door. These
conveniences offered by manufacturers further encourage
35 consumers to store eggs in the door of the refrigerator.

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5 Nearly every home in the U.S. has a refrigerator,
and the power they require add to the already high demand
for electricity. There is a constant tension between the
FSIS recommendations, which encourage adequate
refrigeration to ensure food safety and the Department of
10 Energy (DOE) concerns that stress energy conservation.

15 The Association of Home Appliance Manufacturers
("AHAM") has adopted a standard voluntary testing
protocol (ANSI/AHAM HRF-1-1988) recognized by the
American National Standards Institute ("ANSI") for
testing the efficiency of home refrigerators. The
protocol measures the temperature at strategic points in
the interior refrigerator and freezer chambers over time
while opening and closing the door at defined intervals.
AHAM standards allow consumers to identify which
20 refrigerators use less power and which better maintain
the set temperature under conditions of normal consumer
use (i.e. when refrigerator doors are frequently opened
and closed during the day).

25 Various forms of thermal barriers have been
developed in an attempt to reduce the power consumption
by refrigerators. Thermal barriers reduce the
interaction between the cold interior air of the
refrigerator and the warmer outside ambient air. The
result is a refrigerator that uses less power to retain
30 the set temperature by reducing loss of the cold air when
the door is open. Examples of such known devices are
disclosed in U.S. Pat. Nos. 2,041,258, 4,109,484,
4,288,992, 4,313,485, 4,400,046, 4,429,548, 4,539,819,
5,431,490. Generally, these devices create a barrier
35 between the inner cabinet and the outer environment by
providing rigid drawers or doors, a draped over

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10 U.S. Pat. No. 5,431,490 ("490") has incorporated
the use of a hanging vertical thermal barrier with
vertical slits in a refrigerator having a storage door.
Unfortunately the '490 invention does not continually
retain a storage door temperature at or below the FSIS
15 requirement of 45°F when performing the AHAM test.

As previously discussed, current devices allow the efficient storage of food by creating thermal barriers in refrigerators that do not have storage doors. However, these thermal barriers are unable to maintain 20 temperatures in food storage doors that meet the FSIS recommendations. Therefore, there is a need for a thermal barrier that allows efficient cooling of the storage door while minimizing the loss of coolness from the freshness chamber when the door is open.

Brief Description of the Figures

FIG 1 is a perspective view of a device of the present invention having a protrusion strip mounted in a refrigerator demonstrating alignment of the flaps when the cabinet door is opened.

FIG 2 is a perspective view of a device of the present invention mounted in a refrigerator demonstrating the displacement of alternating flaps by a protrusion strip when the cabinet door is closed.

35 FIG 3 is a graphical representation of temperature
variation of the door storage area using the thermal

5 barrier of the present invention versus the anti-convection current curtain of the '490 patent wherein the cabinet door is opened a set number of times over the thirteen hour test period.

10 FIG 4 is a graphical representation of temperature variation of the freshness chamber using the thermal barrier of the present invention versus the anti-convection current curtain of the '490 patent wherein the cabinet door is opened a set number of times over the thirteen hour test period.

15 FIG 5 is a graphical representation of power usage variation in kiloWatt hours during the twelve hour testing period using the thermal barrier of the present invention versus the anti-convection current curtain of the '490 patent.

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Summary of the Invention

25 In accordance with the present invention a thermal barrier for a cabinet is provided having a door storage area comprising a curtain having vertical slits dividing the curtain into flaps; an attachment device for securing the curtain within the cabinet; and a displacement apparatus for displacing at least one of the flaps from alignment with adjacent flaps when the cabinet is closed allowing air within the cabinet to circulate to the door storage area. The flaps may overlap adjacent flaps, the flaps may be constructed of a translucent material, and the device may further comprise stabilizing adapters affixed to the flaps such as weights.

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35 In one embodiment of the present invention the attachment device may further comprise a mounting means and a connecting rod. The mounting means may be a bracket

5 that may be mounted on the upper surface of the cabinet
or on the two opposing sides of the cabinet. The
connecting rod may be adjustable in length and may be
rotatably affixed to the mounting means. At least one
flap may be connected to the connecting rod such that
10 when the connecting rod rotates the at least one flap is
displaced from alignment with adjacent flaps.

In another embodiment the displacement apparatus may
comprise at least one protrusion that contacts at least
one flap displacing the flap from alignment with adjacent
15 flaps when the cabinet is closed.

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20 ~~In yet another embodiment the displacement apparatus~~
comprises an activation shaft connected to the connecting
rod such that when the cabinet is closed the activation
shaft activates the connecting rod rotating the
connecting rod causing the displacement of at least on
flap from alignment with said adjacent flaps.
Alternatively the activation shaft may activate the
~~connecting rod when the cabinet is opened.~~

In still another embodiment of the present invention
25 the displacement apparatus comprises an electrical motor
connected to the connecting rod and a light sensor such
that when the cabinet is closed the sensor activates the
motor to rotate the connecting rod causing the
displacement of at least one flap from alignment with the
30 adjacent flap. Alternatively, the sensor may be activated
when the door is opened to rotate the connecting rod
causing the at least one displaced flap to come in
alignment with non-displaced adjacent flaps.

In another aspect of the invention a thermal barrier
35 for a cabinet having a door and an inner chamber, the
door having a storage area and the inner chamber having

5 an upper surface, a lower surface and two opposing side
walls is disclosed comprising a curtain having vertical
slits dividing the curtain into flaps; an attachment
device for securing the curtain to the upper surface; and
10 a displacement apparatus for displacing at least one of
the flaps from alignment with adjacent flaps when the
cabinet is closed allowing air within the cabinet to
circulate to the storage area within the door. The
attachment device may secure the curtain from the two
opposing sidewalls.

15 In other aspects of the present invention a kit is
disclosed comprising a thermal barrier described above as
well as in another aspect of the present invention a
method for reducing the temperature within the door
storage area utilizing a thermal barrier described above.

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Detailed Description of the Invention

There are several disadvantages of the anti-
convection current curtain of the '490 patent used to
maintain the temperature within a controlled temperature
cabinet. Specifically the anti-convection current
25 curtain disclosed in the '490 patent does not efficiently
or effectively allow cooling of the door storage area
because the curtain seals this area from the freshness
chamber. In particular the curtain is fastened to the
30 cabinet above the freshness chamber preventing
circulation above the curtain. Further the curtain
extends the width of the freshness chamber preventing
circulation around the curtain. In addition when the
door is closed the shelf pushes against the curtain
35 sealing the storage area at the contact point between the
shelf and the curtain preventing circulation through the

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10 sealing ambient temperature air within the storage area.

~~The securing technique for placement of the anti-
convection curtain disclosed in the '490 patent
interferes with seal between the door and the cabinet may
allow the door to remain partially open.~~

15 The securing technique disclosed in the '490 patent
interferes with the seal between the door and the cabinet
by reducing the attraction between the magnetic seal and
the metal cabinet. The curtain disclosed in the '490
patent is secured along the outer region of the cabinet
20 by a double-sided adhesive tape. When the door closes,
the curtain is compressed between the magnetic seal and
the cabinet causing the magnetic forces to weaken. The
weakened forces allow the barrier to push the door open.
The result is a cabinet that does not seal allowing the
25 air from the inner chamber to leak out.

Placement of the anti-convection current curtain on the exterior surface of the cabinet causes the flaps to swing outward and side to side when the door is opened. In addition when the door is closed the lower portion of the curtain is pushed inward into the freshness chamber by the storage shelf. When the door is opened the curtain is released and swings along an arced path beyond the plane of the freshness chamber allowing air to escape below the curtain. Further, since the door opens along a hinge, the flap opposite the hinge is released first causing the flaps to swing individually. When flaps

5 swing individually air is also allowed to pass through the gaps formed in the curtain. This problem may be enhanced when in a humid environment primarily because the moisture may cause the curtain to adhere to the storage shelf with the door when opened.

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15 ~~In addition, when the door is closed the air within the freshness chamber is compressed and pushes outward allowing them to become pinched between the door and cabinet. Like the securing technique, the pinched flaps weaken the magnetic seal between the door and the cabinet and may allow refrigerated air to escape and may also prevent the door from closing. In addition pinching may cause the permanent damage to the curtain. The result is a curtain that no longer hangs properly allowing air to escape from the freshness chamber.~~

20 Referring now more specifically to FIG. 1 the curtain (12) of the present invention does not seal the storage area within the door from the freshness chamber (10) when the door is closed because by displacing at least one flap from alignment with adjacent flaps, air is
25 free to circulate through the curtain (12) when the door is closed.

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30 ~~The curtain disclosed in the present invention does not interfere with the magnetic seal between the cabinet (10) and the door because the curtain of the present invention is positioned on the interior of the cabinet (10). Therefore the seal is not compromised with the present invention.~~

The curtain (12) disclosed in the present invention is not displaced when the door is opened because the
35 curtain (12) does not rest against the storage area shelves when the door is closed.

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5 In addition when the displacement apparatus (16) is
a rotating connecting rod the displacement occurs by
rotation, and rotation minimizes the angle between the
attachment device (14) and the lower portion of the
displaced flap. When the displacement apparatus (16) is
10 a protrusion strip, the angle between the lower portion
of the at least one displaced flap and the attachment
device (14) is minimized by placing the curtain (12)
within the freshness chamber.

The displacement apparatus (16) disclosed in the
15 present invention is not adaptable to the device
disclosed in the '490 patent.

In particular a rotating rod can not be adapted to
the cabinet of the '490 patent because the curtain is
secured to the outer surface of the chamber by a double-
20 sided adhesive tape.

The attachment of the curtain (12) within the
freshness chamber is also not adaptable to the device
disclosed in the '490 patent. The securing technique
disclosed in the '490 patent teaches the use of a double-
25 sided adhesive tape to secure the curtain. Unfortunately
the upper surface of the inner chamber is often times
uneven and may have design characteristics such as vents,
ducts or thermostat that prevent proper alignment of the
curtain which can result in creation of gaps between the
30 flaps.

*Sub
As* →
~~In accordance with the present invention a thermal
barrier for a cabinet (10) having a door storage area
comprising a curtain (12) having vertical slits dividing
the curtain into flaps; an attachment device (14) for
35 securing the curtain (12) within the cabinet (10); and a
displacement apparatus (16) for displacing at least one~~

5 ~~of the flaps from alignment with adjacent flaps when the cabinet (10) is closed allowing air within the cabinet to circulate to the door storage area.~~

I. The Curtain

10 The curtain (12) may be made of any material known to those skilled in the art that has poor thermal conductance, a low ionic static charge storage capacity, and acts as a thermal insulator. The material used to construct the curtains is dependent on the temperature
15 within the cabinet. In particular, the curtain (12) may be utilized for a variety of purposes such as for a refrigerator or oven. When the curtain (12) is to be utilized for a refrigerated chamber the curtain (12) is preferably made of a material that is able to retain a
20 portion of its flexibility at low temperature such as below 32°F to about -25°F and may have a thickness of from about 0.004 mm to about 0.040 mm, preferably from about 0.01 mm to about 1.00 mm, and most preferably from about 0.01 mm to about 0.25 mm. Preferably the material is a
25 polymer and most preferably a translucent polyvinyl or polypropylene polymer.

When the curtain (12) is to be utilized for a heated chamber the curtain (12) is preferably made of a material that is able to retain a portion of its rigidity at
30 higher temperatures such as temperatures above 200°F to about 500°F and may have a thickness of from about 0.004 mm to about 0.040 mm, preferably from about 0.01 to about 1.00 mm, and most preferably from about 0.01 mm to about 0.25 mm. Preferably the material is a polymer such as
35 silicone.

Sub. A9 5 ~~The curtain (12) may have one or more vertical slits~~
dividing the curtain into flaps. The vertical slits may
extend from the base of the curtain (12) to about the top
of the curtain or may extend to the top of the curtain
(12) dividing the curtain into separate distinct flaps.

10 The flaps preferably are of the same length extending
from the top of the cabinet (10) to the base of the
cabinet (10) such that the chamber formed interferes with
the circulation of ambient air with the temperature-
controlled air within the cabinet. The flaps may have the
15 same or differing widths ranging from about 2 inches to
about 18 inches, preferably from about 3 inches to about
8 inches and most preferably about 4 inches to about 5
inches. The flaps may be aligned side by side or they may
overlap. If the flaps overlap they may form an exterior
20 ~~flap layer and an interior flap layer.~~

II. The Attachment Device

Sub. A10 25 ~~The attachment device (14) may be any device known~~
to those skilled in the art that may be used to secure
the curtain to the inner chamber of the cabinet (10). In
another configuration, the attachment device (14) may be
composed of two or more parts that allow the curtain (12)
to be affixed within the inner chamber such as for
example a rod that supports the curtain (12) and at least
30 one bracket for mounting the rod within the cabinet (10).
In the first configuration the curtain (10) may be
provided with connectors that allow the user to select
and apply the desired connector to the curtain (12) and
cabinet (10). For example providing the curtain (12) with
35 a self-laminating Velcro strip so that the user may
~~attach one section of the strip to the upper portion of~~

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5 ~~the curtain (12) near the top edge and the other section~~
of the strip to the top wall of the cabinet (10). Once
the Velcro sections are in place the curtain may be hung
within the cabinet (10) by re-associating the Velcro
sections.

~~In the other configuration the attachment device~~
(14) comprises at least one mounting means and a connecting rod. The mounting means may be a bracket comprising one continuous piece that is aligned parallel to the connecting rod or may comprise two components one at each end of and generally perpendicular to the connecting rod. When the bracket is one continuous piece, the bracket may be constructed so that it is adjustable to fit a variety of cabinet (10) widths. For example the bracket may be composed of two sections wherein one section is slidably affixed within the other section similar to the telescoping curtain rods used in the window covering industry. Alternatively the two sections may be provided as two interconnecting pieces that may be secured in a desired length by nut and bolt or by clip.

~~The one continuous piece bracket may be secured to the top wall of the cabinet (10) or to the opposing sidewalls by a variety of methods such as screws, rivets, Velcro™, or adhesive. When two brackets are used they may be affixed one on each of two opposing side walls, preferably as close as possible to the top of the inner chamber and in close proximity to the door of the cabinet (10). The bracket may be constructed of any rigid material able to withstand a wide variety of temperature extremes as well as the weight of the curtain during such temperature extremes. Preferably the bracket is made of metal or temperature resistant polymer.~~

5 The connecting rod may be any rigid elongated shaft on which a curtain (12) or curtain flaps may be affixed, that may be mounted to the mounting means and allows at least one flap to be displaced from alignment with its adjacent flaps when the cabinet is closed. The connecting
10 rod may be of fixed length or adjustable in length. If the connecting rod is adjustable it may be, for example, provided as two interconnecting pieces that may be secured in a desired length by nut and bolt or by push lock. The connecting rod may be mounted in the mounting
15 means by a variety of methods known to those skilled in the art. For example, the mounting means may provide a cradle, clip or loop such that each end of the connecting rod may be placed into a cradle or attached to a clip or inserted into a loop. When in position the connecting rod
20 may be stationary or may rotate. Alternatively, the connecting rod may be affixed to the mounting means and the mounting means may rotate. The curtain (12) or curtain flaps may be fastened to the connecting rod directly or it/they may be provided with an adapter on
25 one end that may be slipped onto the connecting rod. For example an adapter may be created by folding over the top of the curtain or curtain flap to form a loop that may slip over the connecting rod. If the flaps or curtain (12) are fastened to the connecting rod so that they move
30 with the rotation of the connecting rod they may be fastened directly to the rod for example by screw or adhesive, or they may be affixed to an adapter on the connecting rod such as for example a metal plate

5 III. The Displacement Apparatus

The displacement apparatus (16) may be any apparatus known to those skilled in the art that allows at least one flap to be substantially removed from alignment with its adjacent flaps allowing the air within the cabinet (10) to circulate into the door storage area when the door is closed. For example a displacement apparatus (16) could be a protrusion strip that physically displaces the curtain flaps by pressing against the flaps when the door is closed. Alternatively, a mechanical displacing apparatus may be utilized that converts the mechanical energy created by closing or opening the door to activate the rotation of the connecting rod displacing one or more curtain flaps. In addition an electronic displacing apparatus may be utilized comprising a light sensor that activates an electronic motor causing the rotation of the connecting rod when the presence or absence of light is detected.

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~~When the displacement apparatus (16) is a protrusion strip, any device that is able to be mounted to the cabinet door and able to push against at least one flap such that it is substantially displaced from contact with its adjacent flaps is preferable. In one configuration when the flaps of the thermal barrier overlap the protrusion strip pushes against the flaps of the interior flap layer. If the cabinet door comprises at least one shelf, the protrusion strip may be mounted to the shelf such that when the door is closed the protrusion strip displaces at least one curtain flap. The protrusion strip may be mounted to the cabinet door by a variety of methods including adhesive, snaps or Velcro. The protrusion strip may be made of a variety of materials~~

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Cont.

5 ~~that maintain their structural integrity over a wide~~
range of temperature variations, is/are able to displace
a curtain flap without causing substantial structural
alteration of the flap and able to withstand the force
exerted by curtain. For example the protrusion strip may
10 be made of a polymer or rubber. Preferably the strip is
constructed of plastic and the protrusions constructed of
rubber. The protrusion may be a set height or may be
adjustable. A preferred height is one that allows the
protrusion to contact at least one flap and displace it
15 from alignment with adjacent flaps, preferably the height
is from about one half inch to about three inches,
preferably from one inch to two inches, and most
preferably from about one and one half inches to about
one and three quarters inches.

20 When a device is utilized to rotate the connecting
rod the rod may be rotated by a variety of methods known
to those skilled in the art including a device activated
by the opening of the cabinet door or alternatively by
the closing of the cabinet door. The rotating device may
25 be activated mechanically or electrically. For example
the device may be mechanical such that when the door is
opened an activation rod is released that rotates the
connecting rod such that the curtain flaps are realigned
from their displaced position when the door was closed.
30 Alternatively, the activation rod may rotate the
connecting rod when the door is closed displacing one or
more of the curtain flaps.

35 If the displacement apparatus (16) is mechanical it
may comprise two springs, the first spring activates the
connecting rod to rotate displacing at least one flap
when the cabinet door is closed and a second spring

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5 activates the connecting rod to rotate in the opposing
direction allowing the at least one flap is aligned with
adjacent flaps when the door is open. Both springs may be
affixed to the connecting rod such as by connecting one
end of each spring to a tongue affixed to the connected
10 rod. The other end of the first spring may then be
connected to either the bracket or the cabinet. The
other end of the second spring may be affixed to an
activation shaft slidably connected to the bracket such
that when the door is opened the pressure exerted by the
15 door on the activation shaft is released and the
connecting rod is rotated bringing the displaced flaps in
contact with adjacent flaps. The bracket may further
comprise a stopping component that prevents the
connecting rod from rotating beyond the point in which
20 the flaps are aligned when the door is open.

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~~Correspondingly an electronic device that comprises~~
a light sensor maybe utilized to rotate the connecting
rod. For example when a refrigerator door is opened the
light inside the refrigerator illuminates, when this
25 occurs the light sensor activates an electronic motor
that rotates the connecting rod aligning the curtain
flaps. Alternatively, the sensor maybe activated by the
absence of light such that when the cabinet door is
closed the sensor registers the absence of light and the
30 electronic motor is activated rotating the connecting rod
and displacing at least one curtain flap. In these
configurations one or more of the flaps may be connected
directly to the connecting rod and thereby displaced when
the connecting rod is rotated. The remaining flaps
35 comprise adapters that allow the connecting rod to rotate
~~freely without rotating these remaining flaps. The~~

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IV. The Stabilizing Adapters

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5 sand. The preferred weight is comprised of two components
of equal weight that may be snapped together through an
aperture made in the lower portion of the flap such that
approximately one half of the stabilizing weight is on
the interior side and the other is on the exterior side
10 of the flap. Weights may not be required if the flap is
constructed of a material heavy enough to prevent the
movement of the flaps when the door is opened or closed.

When the stabilizing adapter (16) is an elastic
cord, the cord may be affixed to the base of each flap by
15 a variety of methods such as for example stitches, glue,
or staples. Alternatively, the elastic cord may be
affixed to the flaps by sliding the cord through a loop
created at the base of the flap. The elastic cord may or
may not be affixed to the interior cabinet. Preferably
20 the elastic cord is affixed to the inner cabinet by for
example tying the cord to metal loops attached to the
inner cabinet sidewalls.

V. Installation

25 The controlled temperature within the door storage
area of a cabinet may be maintained utilizing a thermal
barrier of the present invention.

The thermal barrier device may be provided as a kit
comprising a curtain (12), an attachment device (14), and
30 a displacement apparatus (16). The curtain (12) may be
provided as a single piece or as at least two flaps. In
one preferred configuration the curtain (12) is provided
as a single piece that is pre-slitted such that when cut
into two pieces at 90° to the slits provides a curtain
35 (12) with free hanging flaps for two different chambers
such as a freshness chamber and freezer of a

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5 refrigerator. Alternatively, at least two separate flaps
may be provided in which loops are preformed at each end
such that they may be cut into two individual flaps.
When two flaps are created from one, both flaps may be
for the same compartment in the cabinet or they may be
10 for different compartments such as one for a refrigerator
and one for a freezer. Preferably the curtain (12) is
provided on the connecting rod. In this configuration
alternate flaps are affixed to the connecting rod such
that when the connecting rod is rotated the affixed flaps
15 are displaced.

The attachment device (14) may be selected from any
of those that have the desired characteristics described
above. Preferably the attachment device (14) comprises
two brackets and an adjustable connecting rod. Preferably
20 one of the two brackets further comprises a displacement
apparatus (16) as described above. The two brackets are
securely affixed to the two opposing sides such that the
bracket comprising the displacement apparatus (16) is
affixed to the wall adjacent to the door hinge and such
25 that the connecting rod is parallel to the upper surface
of the inner chamber.

The displacement apparatus (16) may be selected from
any of those having the desired characteristics as
described above. Preferably the displacement apparatus
30 (16) is a mechanical device comprising an activation
shaft affixed to a bracket and in contact with the
connecting rod by a spring such that when the door is
opened the activation shaft is released and the
connecting rod is rotated bringing the displaced flaps in
35 alignment with adjacent flaps. Correspondingly, when the

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5 door is closed the activation shaft is compressed and the connecting rod is rotated displacing at least one flap.

The kit may further comprise stabilizing adapters (18) as those described above. Preferably the adapters (18) have an attachment mechanism that allows penetration
10 of the curtain upon installation at the base of the flaps.

Installation of the thermal barrier into a refrigerator will generally require that the user measure the width and height of the inner chamber, cut the
15 curtain (10) to the corresponding width and height, mount the attachment device (14) making sure that the displacement apparatus (16) is positioned on the side wall adjacent to the door hinge, adjust the length of the connecting rod, and attach the connecting rod to the
20 attachment device (14).

Examples

Example 1

Procedure for Determining the Temperature within the 25 Freshness Chamber and the Door Storage Area for a Refrigerator With and Without a Curtain

The test unit was an eighteen cubic feet Frigidaire Crown Series F44N18DT refrigerator with a freezer top. The temperature measurements were taken over a twelve-
30 hour period and power measurements over a thirteen hour period, including a 1 hour steady state measurement. The electrical power was recorded at the compressor input with an Extech #382860 True RMS Power Multimeter plugged into the electrical circuit and the Frigidaire unit.
35 Recording of the electrical current was taken every fifteen seconds and temperature was recorded every two

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5 minutes. The temperature readings were recorded with a
 Fluke 52 Series II Dual Thermocouple Thermometer. The
 dual thermocouple readings were taken at the upper
 interior storage door and the mid interior chamber area.
 Other temperature readings were taken with the Createware
 10 DR-80 industrial dial refrigerator/freezer thermometers.
 The Frigidaire cabinet conditions were as follows: the
 ambient room temperature was seventy degrees, the cabinet
 was level, there was an eighteen inch clearance area
 around the cabinet, the freezer was set at the warmest
 15 temperature setting, and the Frigidaire temperature was
 set to six on a one to nine scale with nine being the
 coldest.

The procedure was to open the refrigerator door
 between 45° and 90° for fifteen seconds at predetermined
 20 time points. The time points were as follows: no pulls
 during the first hour providing a steady state
 measurement, one pull during the second hour, eight pulls
 during the third hour at seven and one half minute
 increments; four pulls during the fourth hour at fifteen
 25 minute increments; four pulls during the fifth hour at
 fifteen minute increments, one pull during the sixth
 hour, one pull during the seventh hour, one pull during
 the eighth hour, one pull during the ninth hour, four
 pulls during the tenth hour at fifteen minute increments,
 30 four pulls during the eleventh hour at fifteen minute
 increments, eight pulls during the twelfth hour at seven
 and one half minute increments, and one time during the
 thirteenth hour.

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Example 2

Cooling Efficiency Comparison of the Anti-Convection
Current Curtain ('490) and a Thermal Barrier of the

5 Present Invention in the Door Storage Area Following the
 Procedure Described in Example 1

Analysis was performed of hour 3 to determine the cooling efficiency of the storage area. Hour three
10 comprised eight pulls at seven and one half-minute increments. Referring more specifically now to FIG. 3 the lowest temperature within each seven and one half-minute cycle was averaged to determine the average low obtained by each device. Results show that the device
15 disclosed in the '490 patent was able to cool the storage door to an average temperature of 45.1°F during the seven and one half minute cycle. In contrast the present invention cooled the storage door to an average temperature of 39.6°F during the seven and one half-
20 minute cycle significantly below the FSIS safety recommendation of 45°F. This study suggests that the present invention is more efficient than the device disclosed in the '490 patent at retaining the set temperature within the storage door.

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Example 3

Cooling Efficiency Comparison of the Anti-Convection
Current Curtain ('490) and a Thermal Barrier of the
30 Present Invention in the Freshness Chamber Following the
 Procedure Described in Example 1

Sub. A16 → ~~Further analysis was performed of hour twelve to determine the efficiency of each device in retaining the set temperature within the freshness chamber. Hour twelve~~
35 ~~comprised eight pulls at seven and one half-minute increments. Referring more specifically now to FIG. 3~~

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5 the highest temperature within each seven and one half-
minute cycle was averaged to determine the average high
obtained by each device. Results show that the standard
refrigerator had an average high of 50.8°F, the device
disclosed in the '490 patent had an average high
10 temperature of 43.7°F, and the present invention had an
average high of 35.2°F. This study demonstrates that the
present invention is more efficient at retaining the
temperature within the freshness chamber than a standard
refrigerator and the device disclosed in the '490 patent.

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Example 4

Power Use Results from Testing the '490 Device and the
Present Invention versus a Control (No Barrier) According
to the Procedure in Example 1

Seal
A17

20 ~~Power consumption was measured over the thirteen~~
hour testing period to compare the power required by a
standard refrigerator and a refrigerator equipped with
the thermal barrier of the present invention. Referring
now specifically to FIG. 4 the results demonstrate that
25 the standard refrigerator consumed 1.24 kWh while the
refrigerator equipped with the thermal barrier of the
present invention consumed only 1.09 kWh over the
thirteen hour test period. Consequently, the refrigerator
equipped with the thermal barrier of the present
30 invention utilized 12.10% less power than the standard
refrigerator.